P1 1124845

THE UNITED STATES OF AMERICA

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February 11, 2004

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APPLICATION NUMBER: *60/430,996*
FILING DATE: *December 04, 2002*
RELATED PCT APPLICATION NUMBER: *PCT/US03/38011*

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12-05-02 60430996 .120402 APRO

JC698 U.S. PTO 12/04/02

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PTO/SB/16 (8-00)
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Valter Khaled	Drazic Sarayeddine	Betton, France Nouvoitou, France

☒ *Additional inventors are being named on the 1 separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

SIMPLIFIED TWO STAGE PROJECTOR ARCHITECTURE

CORRESPONDENCE ADDRESS

Direct all correspondence to:

☐ Customer Number → *Type Customer Number here* — *Place Customer Number Bar Code Label here*

OR

☒ Firm or Individual Name	Joseph S. Tripoli - THOMSON MULTIMEDIA LICENSING INC.				
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City	PRINCETON	State	NJ	ZIP	08543-5312
Country	USA	Telephone	609-734-6834	Fax	609-734-6888

ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 7 ☐ CD(s), Number

☒ Drawing(s) *Number of Sheets* Inclusive ☐ Other (specify)

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

☐ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees

FILING FEE AMOUNT ($)

☒ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 07-0832 — 160

☐ Payment by credit card. Form PTO-2038 is attached.

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: ____.

Respectfully submitted,

SIGNATURE Richard LaPeruta

Date 12/04/02

REGISTRATION NO. *(if appropriate)* 51,252

Docket Number: PU020474

TYPED or PRINTED NAME RICHARD LAPERUTA, JR.

TELEPHONE 717-295-6207

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

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60430996.120402

PROVISIONAL APPLICATION COVER SHEET
Additional Page

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Docket Number	PU020474	Type a plus sign (+) inside this box →	+

INVENTOR(S)/APPLICANT(S)

Given Name (first and middle [if any])	Family or Surname	Residence (City and either State or Foreign Country)
Estill Thone	Hall, Jr.	Fishers, Indiana USA
Eugene Murphy	O'Donnell	Fishers, Indiana USA

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Express Mail Label No.: EL657206578US

DN:3CP929474.120302

1. Title:	Simplified two stage projector architecture

2. Inventor (s) Information

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A. Brief summary of the invention

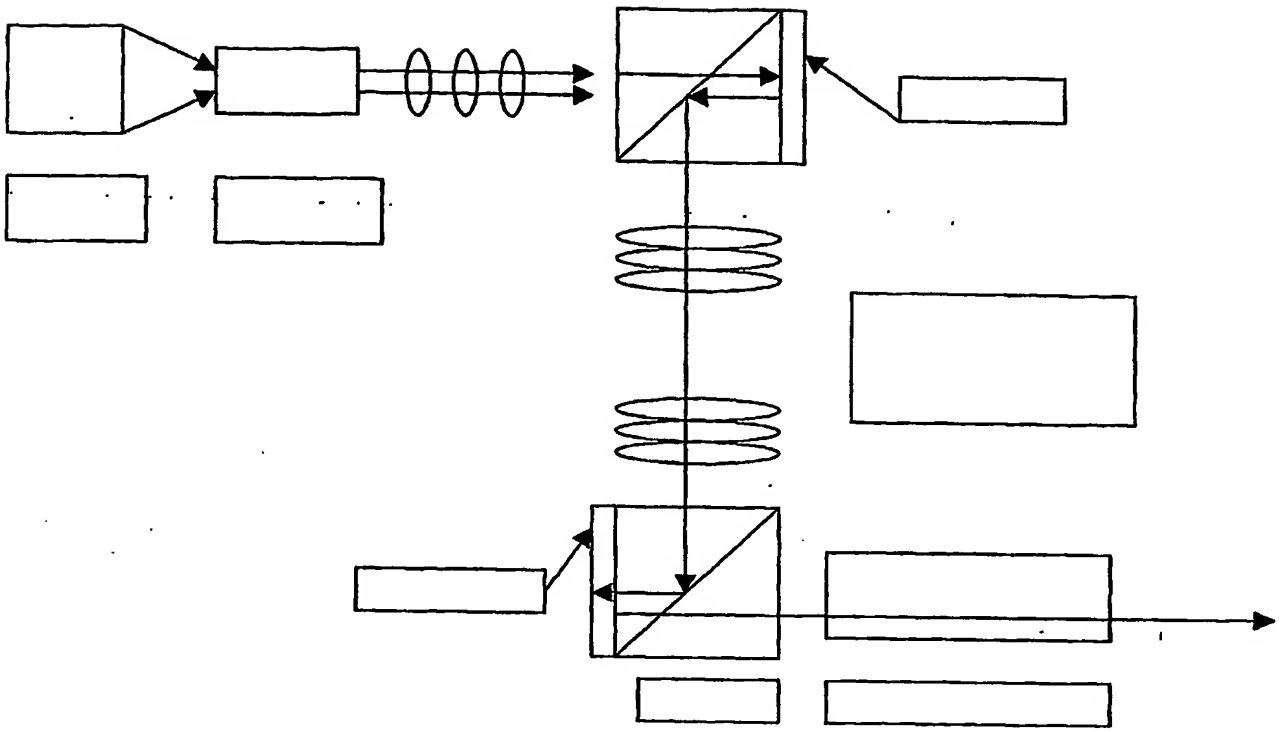
This is a novel two stage projector architecture with less optical elements that is also more compact than the original one.

B. Background of the Invention

In the previous art, the number of optical elements used for solving the problem of the contrast and contouring was 6 lenses of the imaging relay system needed for imaging one imager onto another. (See next figure).

Inventor Full Signature (Full first, middle and last names)	Date	Inventor Full Signature (Full first, middle and last names)	Date
Inventor Full Signature (Full first, middle and last names)	Date	Witness Signature Invention read and understood by me	Date

The contents of this invention disclosure are for confidential use only and are not to be disclosed in any manner in whole or in part without the permission of Thomson multimedia Licensing Inc.



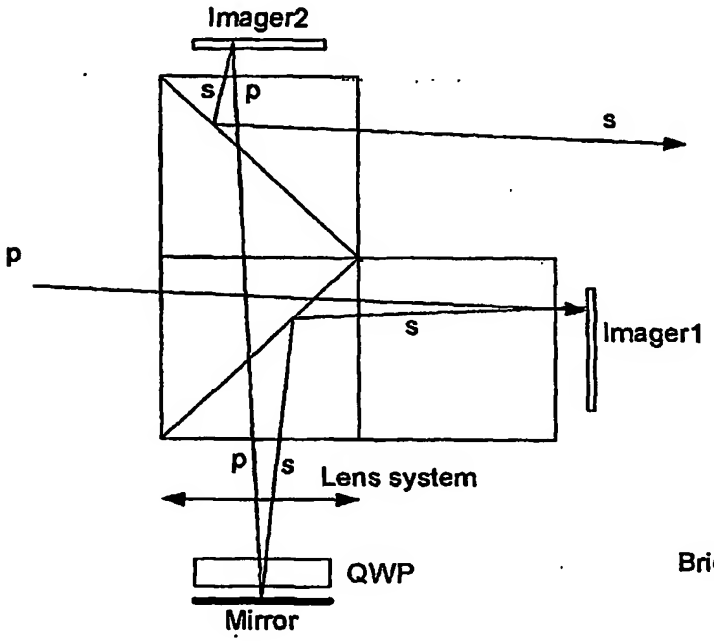
The purpose of this new disclosure is to reduce the number of lenses to 3 ones, as low cost as the those used in the previous art and also making the system more compact.

C. Description of the invention

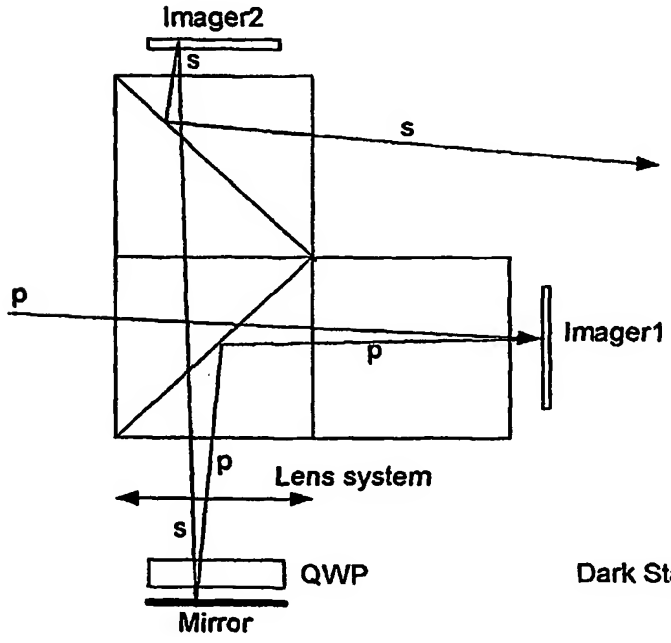
The idea is to take advantage of the perfect symmetry of the above system to reduce the number of elements. In particular, there are 3 lenses before an aperture stop in the one to one relay lens, and three after the aperture stop. The relay system can be designed such as the first group of 3 lenses is absolutely identical to the second group of three lenses. And hence, we can imagine then using just the first group of 3 lenses and a mirror in the aperture stop to double pass the first 3 lenses which could enable us to get rid of the 3 lenses located after the aperture stop. The system would look like the following figures where the lens system element represents the group of three lenses. It is clearly seen that the dark state obtained by the first imager is modulated on a pixel basis by the second imager which is also driven in the same state so that the contrast of the dark state is boosted like in the previous disclosure, enabling at the same time to have a very high contrast system (>40000:1) and doubling the depth of addressing because we use two imagers. The system needs a polarized sequential field colour illumination or a polarized scrolling color illumination.

In the previous art, we had 6 lenses, here 3 lenses, a glass cube that is just here as a path equalizer for the relay lenses for both channels, and a mirror with a broadband

QWP laminated on it. So we have traded 3 lenses for a glass cube and a mirror+QWP but the system is already more compact than in the previous art.



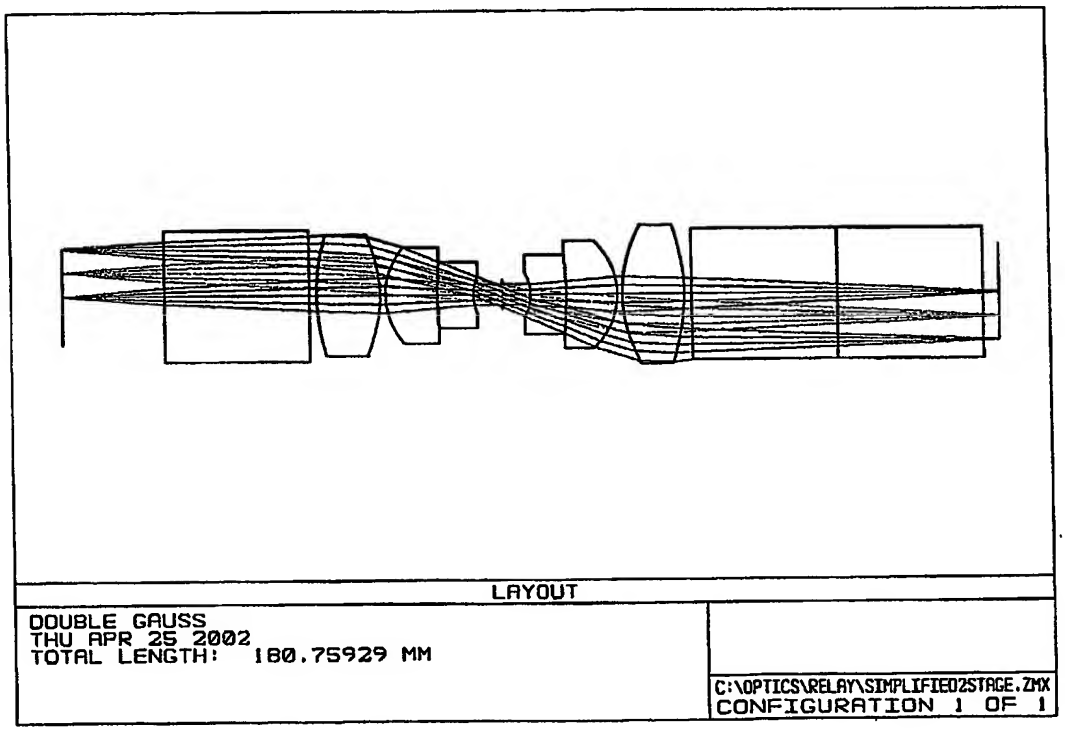
Bright State path

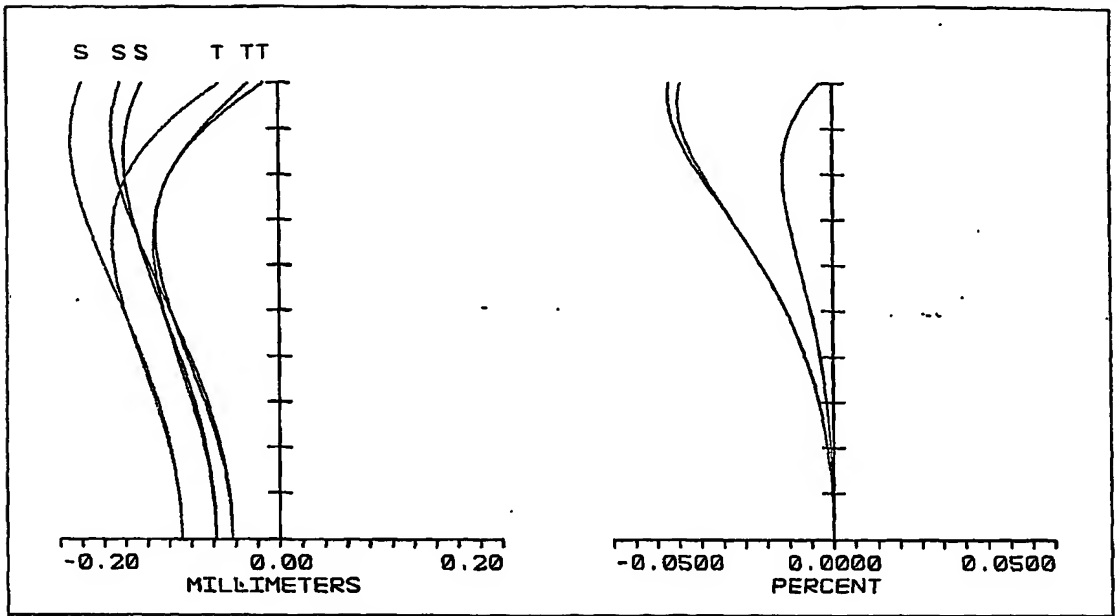


Dark State path

The next step is to try to find out if the additional glass cube could be removed and replaced by just a distance from the first imager to the PBS that is different from the distance of the second imager to the PBS. This is not obvious at all, because the three lens element is used in a symmetrical double pass and it shall make the image of the first imager onto the second one with the same 7 constrains that we got in the disclosure about the previous art: telecentricity, low distorsion, very good MTF, a speed of 2.8, magnification of −1 and inexpensive glasses. If we unfold the path, and constrain the design to have 2 identical group of three lenses and that both groups are at the same distance from the 2 PBSs whereas the imagers do not need to be at the same distance from the PBSs, the figure below shows an optimized configuration of the relay lens group that fulfills the requirements.

The two figures after that one show that the distorsion is excellent and that the good MTF ensures a proper imaging of one imager onto the other one.





FIELD CURVATURE / DISTORTION

DOUBLE GAUSS
THU APR 25 2002
MAXIMUM FIELD IS 10.200 MILLIMETERS
WAVELENGTHS: 0.486 0.588 0.656

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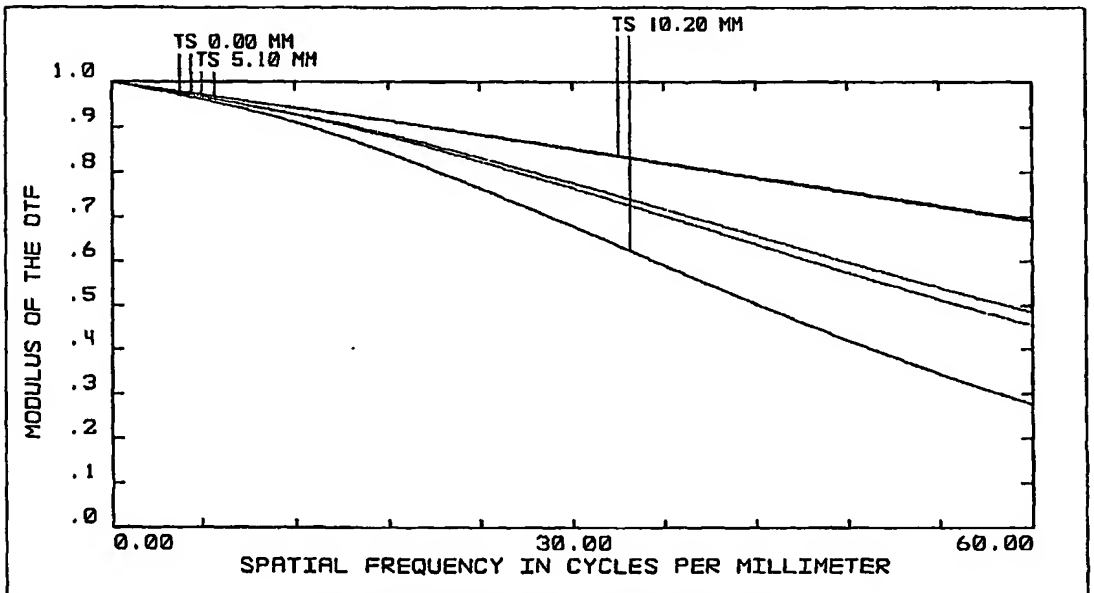
CONFIGURATION 1 OF 1



POLYCHROMATIC DIFFRACTION MTF

DOUBLE GAUSS
THU APR 25 2002
DATA FOR 0.4861 TO 0.6563 MICRONS.

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CONFIGURATION 1 OF 1

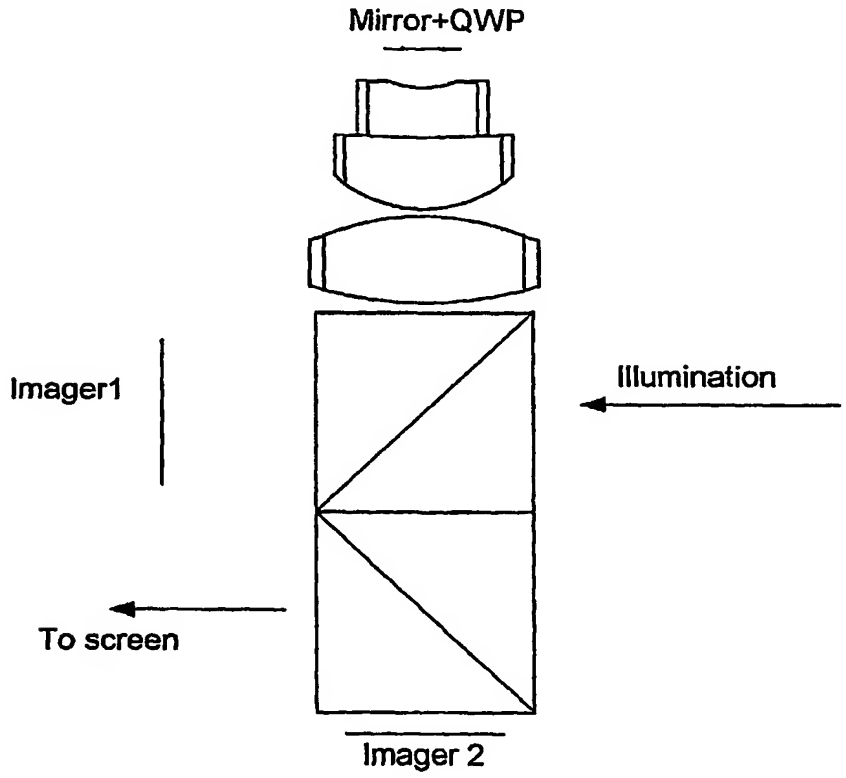
The performance summary for the lens is:

Effective Focal Length : 243.0867 (in air)
Effective Focal Length : 243.0867 (in image space)
Back Focal Length : -240.2476
Total Track : 160.935
Image Space F/# : 1.375713
Paraxial Working F/# : 2.75153
Working F/# : 2.79508
Image Space NA : 0.1787892
Object Space NA : 0.1788022
Stop Radius : 4.552487
Paraxial Image Height : 10.20077
Paraxial Magnification : -1.000075
Entrance Pupil Diameter : 176.6987
Entrance Pupil Position : 466.3308
Exit Pupil Diameter : 176.6987
Exit Pupil Position : -486.2808
Field Type : Object height in Millimeters
Maximum Field : 10.2
Primary Wave : 0.5876
Lens Units : Millimeters
Angular Magnification : 1

And it's prescription:

SURFACE DATA SUMMARY:

Surf	Type	Comment	Radius	Thickness	Glass	Diameter	Conic
OBJ	STANDARD		Infinity	19.82429		20.4	0
1	STANDARD		Infinity	28	SF2	26.74929	0
2	STANDARD		Infinity	1.457079		32.16696	0
3	STANDARD		47.25938	12.01184	BAK2	33.58872	-1.021197
4	STANDARD		-29.12938	0.9996844		33.36579	-2.209548
5	STANDARD		16.44959	10.00551	BAK2	25.54432	0
6	STANDARD		121.3619	7.005045	SF15	20.37508	0
7	STANDARD		10.52292	5.510076		11.49384	0
STO	STANDARD		Infinity	5.510076		9.737583	0

9 STANDARD	-10.52292	7.005045		SF15	12.92177	0
10 STANDARD	-121.3619	10.00551		BAK2	23.27955	0
11 STANDARD	-16.44959	0.9996844			27.50165	0
12 STANDARD	29.12938	12.01184		BAK2	37.49786	-2.209548
13 STANDARD	-47.25938	1.457079			37.57717	-1.021197
14 STANDARD	Infinity	28		SF2	35.41905	0
15 STANDARD	Infinity	0.01			28.50347	0
16 STANDARD	Infinity	28		SF2	28.49931	0
17 STANDARD	Infinity	2.946528			21.58373	0
IMA STANDARD	Infinity				20.41337	0

The next figure shows the distances at scale once the system is folded with a mirror and a QWP in the aperture stop.